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Remote Adaptive Communication System

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Abstract- **This paper presents a new approach to the development of communcation tools for handicapped people. The aim is to provide with a set of capabilities which allows them to interact with their environment.**
The new methodology that we are presenting is inspired in an open architecture for people with disabilities. This methodology allows them to carry out tasks that are taken for granted by most of us.

I. Introduction

Information technology is playing an important role in society today. The latest trends in the telecommunications industry lead us to believe that wireless-computing environments will dominate the market in the coming years and different devices will come together to form a new kind of wireless personal device [1, 2, 3]. New developments must be ready for this distributed computing scenario, and software tools should make use of telecommunication networks in order to gain capacity.

Disabilities, and especially those that affect communication, keep people from accessing information channels. Consequently, they are not afforded the same opportunities as most of us. Different institutions have recently tried to develop methodologies and special languages for these people. For example, Bliss language [4, 5] and SPC [6] have been widely used for people with communication disabilities. Furthermore, some software tools have tried to mechanise these methodologies. However, we think we must make use of new telecommunication technology in order to apply what it offers us [7, 8]. Some researchers have already tried to use these technologies for distance education [9].

Other fields such us healthcare services have made use of information technology. The rational use of telemedicine is becoming a cost-effective solution in the treatment of patients with atypical circumstances [10, 11]. New platforms are developed for telediagnosing [12] and the results are encouraging. Working in this direction, we developed a new methodology by endowing classical ideas with new technology. We have consequently made use both of new languages for handicapped people and the possibilities that information technology offers. In this paper we are presenting on the one hand a new methodology for developing communication tools for handicapped people and on the other, a tool which has been developed using this methodology.

This paper is structured in the following way: Section 2 deals with special languages and devices. Section 3 presents the methodology and section 4 describes the software tool we have developed using the methodology. Finally section5 shows our conclusions.

II. SPECIAL LANGUAGES AND DEVICES

People who suffer disabilities usually need special devices for establishing communication with their environment [13, 14, 15]. These devices are usually called Adaptive and Augmentative Devices.

There are six major categories we can use to classify Adaptive and Augmentative Devices:

1. **Manual Communication Boards**: They are boards consisting of graphic items. These items may feature different sizes depending on the users' ability. Their aim is to improve children's understanding of messages. These boards are employed with young children who have very limited vocabulary. The problem is the manual nature of the process: somebody must show the board to the child and be present during the communication process (see figure 1).
2. **Simple or Low Cost Voice Output Devices**: These devices provide voice output. A set of available messages can be selected by pressing a key, and the selection process produces the output of that message. These devices contain a limited number of messages, and this means that they must be reprogrammed in order to allow new messages.
3. **Layering Devices**: Several levels are available. Each can be programmed with different messages. Users can change from one level to another by means of some action –such as pushing a button- thus changing the overlay.
4. **Devices using Icon Sequencing:** This kind of devices organises languages in an ordered array of pictures. By pressing a sequence of keys the user selects pictures and constructs messages.
5. **Dynamic Display Devices:** These are devices that use computers to represent pictures on a screen. Pressing a picture on the screen produces a message.
6. **Speech Synthesisers: T**hese allow the user to produce spoken messages by typing texts. The user must have good spelling skills.

Our aim is to develop a methodology featuring the main advantages of every category, offering an environment which allows us to meet all the requirements described. This methodology has been the natural evolution of previous research concerning icon sequencing and dynamic display devices [16, 17, 18]. That methodology was the basis for a set of software tools used in a number of schools for handicapped children (Colegio Virgen de la Esperanza, Algeciras, Spain and Colegio San Juan de Dios, Seville, Spain).

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Abstract

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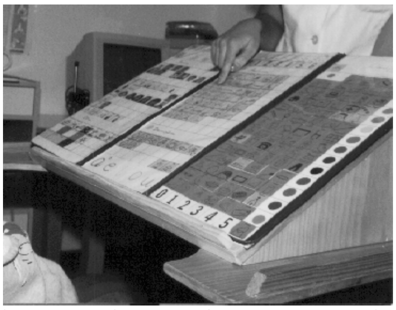


Fig. 1. Manual process of sentence construction.

III. SOFTWARE TOOLS AND DISABILITIES

When software for handicapped people is being developed, some issues must be taken into account; firstly, the user interface must be simple. Using software is sometimes difficult for people if the interface is not intuitive and user-friendly. If we are dealing with people who lack some skills, a special stress must be put on interface design. Secondly, due to differences between handicapped people, interfaces should allow easy adaptation to users' needs. In this sense interfaces must be flexible in this respect. Thirdly, special languages employed by users in their everyday work must be implemented within the software. These languages are usually composed of icons and graphical components that need to be included in the software tool. Users loose their fear to computers if they encounter languages with which they are already familiar.

People with severe communication disabilities frequently need a set of graphical items to display their language. These symbols are placed on a board that is manually shown to the user by his/her teacher (via a sequential procedure). All the items are marked, in order for the user to select which of them is to compose the sentence that he wants to express (figure 2). This way of working is cumbersome due to the manual construction or modification of the board for each user. Managing graphical information by means of manual procedures is usually difficult.

Lately, new software tools have been developed that are capable of automatically managing graphical languages [18, 19]. Sometimes these tools cannot be personalized, which represents a serious problem. This is caused by the heterogeneity of handicapped people's abilities.

The methodology we are proposing must offer several features: The software that we developed under the methodology should be enough flexible to allow easy modifications. (this would permit the same software to be adapted for different people). The methodology should at the same time endow ideas proposed by teachers and medical specialists [20]. Above all, We want to develop a software tool which allows people with communication problems to express their thoughts orally without constraints. Finally, all these ideas must be implemented using telecommunication technology. This helps people to access remote information and also communicate with remote people.

IV. METHODOLOGY

We wanted our architecture and our methodology to allow us to develop software tools that were capable of being used from a distance. Regardless of user location, thanks to telecommunication networks, communication had to efficiently take place. In our methodology communication with people is similar to communication with devices. The sender will always be the software that handicapped users manage. Messages will always be sent to receivers, and sometimes they will be oral messages and sometimes orders to devices.

When we talk about devices we are talking about objects that people use daily. For example, a television set or a light can both be receivers. Users will thus be able to manage any of the elements in the user's environment. These elements can be considered a receiver to which the user can send orders. We encapsulate devices in a similar way to Object Oriented software engineering when it uses software components and messages [21]. Adding a new device to the system will be as simple as designing its interface for managing messages and the kernel will consequently remain unaltered [Figure 2 shows us relationships between interacting components].

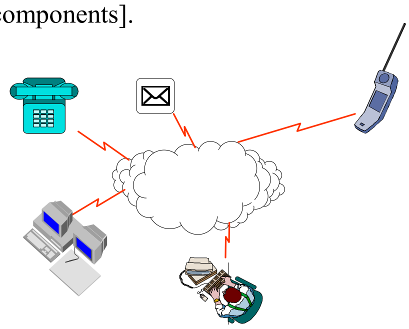


Fig. 2. The user can manage several different devices using the software tool

A. *Client/Server Architecture*

The architecture we are proposing is based on the Client/Server model (see figure 3). We want both client and server to be accessible from anywhere via internet. The computer, acting as a server, is in charge of physically storing applications.

The server is also in charge of centralising and managing all of the configurable components, thus allowing them to be available everywhere at any time. This module runs on an internet server computer. It manages users' accounts and statistics.

On the other hand, each of the client applications will act as sender or receiver, depending on the associated interface: user interface or device interface.

B. *Managing languages and interfaces*

Each user will employ a different number of linguistic items depending on his/her characteristics and specialist advice. Speciaist are consequently in charge of designing languages. We provide a set of tools which will allow them to develop languages in a very simple way.

Data is stored on the server. Both users and languages make up the database. The server will thus provide languages and interfaces to client modules, depending on the user who is acting on the client side.

We are also trying devices to understand these special languages. Suppose all the devices possess a network interface and are always awaiting orders from the net. These devices will act as clients and will receive instructions. For example, a washing machine can await some washing order. It can then inform the server about the termination of the process.

Who is in charge of designing these languages? The answer is clear: the teachers. We provide them with the basis for this system, and we then let them design linguistic components and create a complete set of symbols to form the language. As we will see below, we also provide them with a number of tools which enable them to add special instructions to the symbols; and finally, we give them network devices. These are capable of receiving such a set of orders, e.g. connecting or disconnecting devices that are attached to these network cards. Furthermore, we allow them to create new instructions and assign them functionality by programming network cards. In fact, the process of managing devices will be as simple as sending electronic mails (to electronic counterparts).

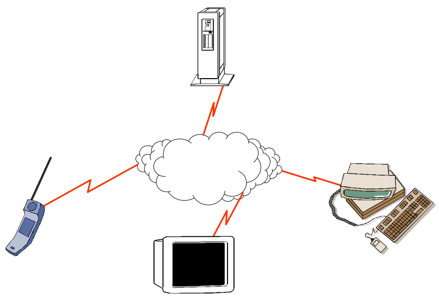
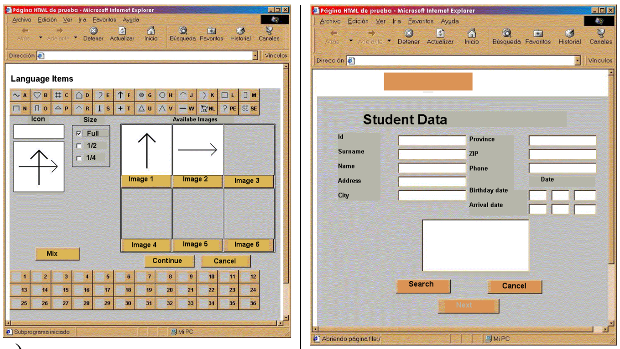


Fig. 3. Client/Server architecture making use of Internet. Several kind of client devices: Cellular phone, personal computer, television set and so on.

V. RESULTS: THE SOFTWARE TOOL

Our aim has always been to develop software that is capable of running on any kind of computer or device with internet access. This was one reason why we chose *java* to write the software. Actually, software developed with java can run on any internet navigator, and any modern device has this capacity. We know that industry is trying to convert cellular phones into a kind of portable computer since these new devices have access to the internet. Any software developed for Internet is thus suitable for use with cellular phones.

The software must be open enough to let us to design new languages. But, at the same time, it should be able to manage existing languages for handicapped. One of these is *bliss*. Bearing in mind the success it has had over the years, maybe new languages for handicapped people will share some features with bliss in the future. We have thus developed the *language design tool* with a view to working with bliss as well as with any other graphical language that one could imagine. The tool for designing languages therefore enables us to add new features to a previously designed language (any kind of action that can be performed from the user interface, such as switching any device on/off).



a) b)

Fig 4: Graphic user interface. a) Managing languages b) managing users

We want the tool to be accessible, in the sense of being usable from any distant computer. Figure 4 shows the Graphical User Interface that this tool provides. The tool runs via Internet, and any navigator can access the site where the tool is available. Teachers will consequently be able to develop languages regardless of their physical location.

The tool enables teachers to manage some basic symbols for *bliss*, at the same time as creating new composed symbols. These new ones are made up of basic symbols and other graphical items such as photographs, scanned images and so on. Figure 5, a), shows a combined symbol made up from several basic symbols.

Symbols will then compose languages, and these languages must be adapted to each user. A database meanwhile stores information about users and languages. This database is also managed by teachers, and is in charge of saving any information concerning users' choices. Teachers decide which of the symbols from a generic language –which has been previously designed- will be included into a user language. For example, we could thus have the generic *summer language* (which includes symbols for *sun, beach, sea* ...) and one *specific summer language* without a number of those words (because they are never employed by the user in question. For example, without the word *beach* if the user has never gone to the beach and doesn't know it). Figure 5 shows the interface that allows teachers to prepare a specific language for each of the users.

We also provide teachers with the chance to monitor users' actions. Each time the handicapped person uses his/her own interface and language, any action is stored in the database. This information will later be used for generating statistics about users' capabilities. Teachers will study these statistics in order to understand improvement in users and also to adapt languages to them. As we said above, the software tool can be run from any distant point, thus allowing teachers to work with remote users. This will allow teachers to reach users otherwise isolated by physical barriers. We are therefore providing not only a tool which helps teachers to work with handicapped people in a comfortable way;

moreover, we are extending their range of resources. In the past, handicapped people had to be moved to the teacher's location, but now, thanks to rational use of technology, we are in one sense moving teachers to the users' location, and this movement is not physical but virtual. Teachers are brought closer to users via software developed for and over Internet.

The software tools have been tested over a wide Spanish region. A number of special education center are using the software. The new developments and improvements are taking into account specialists and users advises.

VI CONCLUSIONS

We have presented a methodology that provides us with a framework for designing and building software tools for handicapped people. These software tools are endowed with internet technology, and can thus be used from remote points.

The set of tools available now is being used in a large Spanish region, Andalucia. Several schools for handicapped children are now testing the software tool and also giving us information about new requirements and improvements.

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